SUBJECT: The Effect of a 100 Hour Translunar Flight Time Constraint on Non-free Return Lunar Accessibility - Case 310
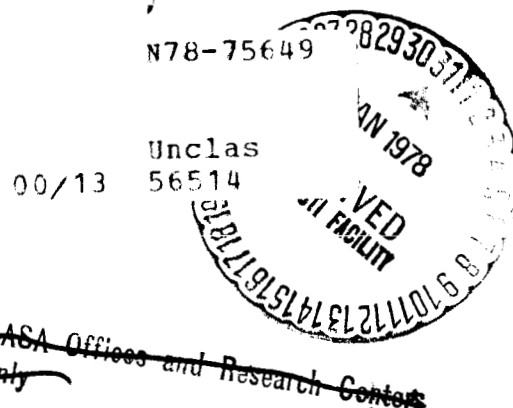
DATE: January 10, 1966

FROM: J. S. Dudek
W. D. Kinney

ABSTRACT

A measure of the loss in non-free return lunar accessibility which results when the translunar flight time is limited to 100 hours has been determined. Four representative lunar arrival dates with unrestricted flight times ranging up to 126 hours were selected for study. A comparison of the accessibility contours obtained for the restricted and unrestricted flight times shows that the western boundary of the accessible region is the only one affected and that the resulting loss in accessible area is at most 6% for any given arrival date. In particular, the entire Standard Apollo Block (± 5° latitude by ± 45° longitude) remains accessible on every day.

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MEMORANDUM FOR FILE

Introduction

The results of a lunar accessibility study using non-free return translunar trajectories were recently published in Reference 1. In determining the accessible area on the surface of the Moon for that investigation, the translunar flight time (or equivalently the translunar injection energy) was nominally unconstrained. The purpose of this memorandum is to discuss the effect on non-free return accessibility if the translunar flight time is restricted to be 100 hours or less.*

Method of Approach

The results presented in Reference 1 include accessibility contours for 44 lunar arrival (deboost) dates distributed over the 20 year period from 1968 to 1987. Translunar trajectories with flight times exceeding 100 hours contributed to the boundaries of 24 of these contours. In order to estimate the effect of the flight time constraint, the accessibility curves for four arrival dates with long flight times (up to 126 hours) were recomputed with the flight time restricted to 100 hours.

Results

The greatest flight time encountered in the original study was 126 hours and corresponds to the arrival date November 29, 1977. The loss in accessible area for this date

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*In the free return case the translunar flight time is always less than 100 hours.
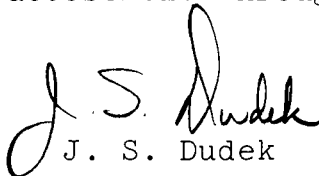
which results when the time of flight is limited to 100 hours is shown as the shaded region in Figure 1 and comprises only about 6% of the original area. This figure also shows that the eastern boundary of the accessible region is not affected by this constraint.
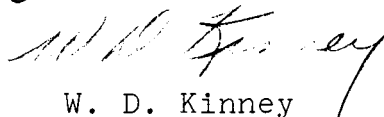
The accessible areas for three additional arrival dates with maximum associated times of flight of 121, 118, and 114 hours were also recomputed, and the loss in accessible area was found to be from 2 to 4% of the original area. The resulting contours are not materially different from that shown in Figure 1 and therefore are not presented here. In each case the extreme polar regions of the Moon remain accessible, and the western boundaries are the only ones affected by the constraint.

Although only four arrival dates have been examined, the results obtained are typical of the results which would be obtained for any other dates.

Conclusions

Based on the results obtained for the four selected arrival dates, it is concluded that limiting the translunar flight time to less than 100 hours causes at most a 6% reduction in the accessible area for any given arrival date. The area lost in each case lies in the western hemisphere of the Moon and has the general appearance shown in Figure 1. Although the resulting loss in the monthly and long term accessibility has not been explicitly determined, no appreciable reduction in accessible area is to be expected. In particular, the entire Standard Apollo Block remains always accessible throughout the 20 year period studied.

J. S. Dudek

W. D. Kinney

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REFERENCES

1. Dudek, J. S.; Kinney, W. D.; and Smith, K.; "A Study of the Behavior of Lunar Accessibility Over Extended Time Periods, Part II – Non-free Return Trajectories," Bellcomm Report TR-65-310-1, October 22, 1965.

STANDARD APOLLO BLOCK

- ARRIVAL DATE - 29 NOVEMBER 1977.

- THE SHADED AREA REPRESENTS THE REDUCTION IN ACCESSIBILITY RESULTING
  FROM THE 100 HOUR FLIGHT TIME CONSTRAINT.

FIGURE 1 - TYPICAL REDUCTION IN NON-FREE RETURN LUNAR ACCESSIBILITY
FOR A SINGLE DAY WHEN THE TRANSLUNAR FLIGHT TIME IS
RESTRICTED TO 100 HOURS